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A. Stecher D.F. Wentworth J.K. Couchman J.C. MacBean

Examining Your Environment

Running Water

A GUIDE FOR TEACHERS

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xamining Your Environment

Running Water

GUIDE FOR TEACHERS

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ONTENTS

roduction .... *iv*
Selecting Activities .... *iv*
Guiding Student Inquiry .... *v*
How to Use this Guide ....*vii*

The Turning of a Tap 1

prinklers, Hoses and Nozzles 8

lopes, Grades and Gutters 15

oving the Earth 21

liography 27

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INTRODUCTION

Usually when water is studied as an out-of-school topic the focus is on large bodies of water such as oceans, lakes and rivers. With growing frequency, studies are also being made of ponds and streams in areas relatively close to the school. These studies when conducted on site, can be most worthwhile in assisting the learner to understand better the world around him. In order to study these bodies of water it is often necessary to plan rather lengthy bus trips, since few schools are so fortunate as to have streams, ponds, lakes, oceans, or rivers on their doorstep. All students can, however, study water as it is presented in *Running Water*. The water that is studied is that which falls as rain, is available from a garden hose or is found in the water system of a house or a municipality. It is not necessary to organize bus trips; the pupils need only step outside the door of the school or home in order to do the activities. These can be repeated as often as necessary and can also be fitted in conveniently with other tasks since the out-of-doors becomes in reality only an extension of the classroom.

The activities in *Running Water* permit the pupil, through personal experiences, to become acquainted with some simple concepts of conservation. In an intimate way he becomes better aware of how man has affected his environment. The simple, everyday things that he has perhaps taken for granted because they are so common and part of his daily life, can now be seen through new eyes -- there is a planned purpose to much that man has done.

Although many of man's achievements have resulted in a pleasanter and more convenient existence for us all, some of the changes man has made to the environment have not been beneficial. The pupils should be encouraged to examine and redefine their values with regard to the progress man has made in using running water. The sections entitled SUGGESTIONS FOR VALUE TEACHING provide the pupils with an opportunity to discuss and explore these values after the activities have been completed.

No attempt is made to deal exhaustively with running water, but rather to introduce avenues of investigation which can be explored more deeply by the pupils once their interest has been aroused. It is hoped that the teacher will encourage the pupils to raise questions and to delve further into areas that have captured the pupils' interest.

Selecting Activities

Many of the activities in *Running Water* can be carried out at any time of the year, but they are best done in the spring, summer or autumn. Since most can be done at any time selected by the teacher, they are excellent activities for pleasant, warm, sunny days. *Running Water* can be completed comfortably during a six- to eight-week period.

The chapters in *Running Water* need not be followed sequentially, since each is quite independent of the others. Within each chapter, however, it is best that the listed sequence of activities be followed, since each activity leads logically into the next.

Refer to the headings SKILLS AND TECHNIQUES and EQUIPMENT AND MATERIALS for each activity. Select activities that teach skills you believe to be lacking in your pupils, or activities that can be used for developing interest and motivation. If you feel that the activity is suitable and that enough equipment can be obtained, then organize a lesson or a series of lessons based on that activity. If it is impractical to carry out a particular activity, perhaps a variation can be substituted. Once the skills have been mastered, the pupils can be encouraged to employ them to find out more about what interests them.

iding Student Inquiry

e of the photographs in the pupil's text show boys and girls doing investigations.
se photographs illustrate techniques that might otherwise be difficult to under-
nd. The captions usually provide questions that guide the pupils to interpret the
n ideas and draw attention to subtleties of technique. Other photographs illustrate
nomena related to problems that the pupils might be investigating. Before attempting
h activity, direct your pupils to read the captions carefully. By discussing the
tographs and captions in small groups or as a class, your pupils can gain insight
o the content of the chapter. Hopefully, some photographs will stimulate questions
t will lead to activities that the pupils themselves devise and conduct. When this
pens, your pupils will have progressed to the threshold of open-ended inquiry, a
e desirable type of learning experience. The quality of these open-ended investiga-
ns will depend on the skills developed from more directed activities and on your
lity to provide guidance at critical times.

Diagrams, charts, graphs, and drawings are included to guide the pupils in con-
ting their activities or to help them in recording their data. Encourage the pupils
use these aids. Discussion of the illustrations by pupils in small groups can help
clarify the ideas presented in the activities.

To organize your classroom, set up several learning stations with different activ-
es from the same chapter. The equipment and materials necessary for each activity
uld be readily available, either at each station or elsewhere in the classoom. The
ks, open at the appropriate pages, can be used as work cards. You might find it
essary to organize data-collecting sheets for the pupils. Some type of rotation can
o be employed to take the best advantage of the learning stations. For other sug-
tions, refer to the series overview, *Examining Your Environment, An Introduction for
chers,* pages 31 to 37.

Almost all the activities are best done by pupils working in small groups. It is
ortant that pupils be guided by the teacher in the proper functioning of groups;
responsibility of each group member must be clearly delineated. If necessary,
lls and techniques should be practised before the activity commences so that a
sonable level of achievement is attained and each member of the group thoroughly
erstands his role. All the materials required to carry out each activity should
collected beforehand.

Very little formal equipment is required; much can be brought from home, and some
ple pieces of equipment can easily be made. The success of the activities will
ge on the pupils' ability to observe carefully and record observations clearly.

Fairly heavy emphasis is placed on the pupils' acquiring information from various
ple in the community. Interviewing skills should be discussed and deliberate
rts made to refine this method of learning. Interviews are most successful if the
ils plan beforehand what it is they wish to find out. A list of questions should be
wn up to cover the scope of the area under consideration. The interest and prepara-
n displayed by the pupils will affect the response that they receive from the
son being interviewed.

sequence of steps for carrying out an activity might be:

The pupils could read the activity carefully and organize themselves to conduct
the investigation from beginning to end.

Pupils could invite you to their group and outline their plans for your approval
and revision, if necessary.

They could conduct the investigation.

4. The pupils could answer the *Digging Deeper* questions.
5. A reporting session can be organized so that you gather feedback on how well the groups have progressed. The pupils then have a chance to report and compare their findings with other pupils. New avenues of investigation, as well as skill teachin and reteaching, can grow out of this reporting session.

Once the students have completed the initial investigations as a class endeavor, you might invite them to pursue new investigations. For this, you could organize the pupils into groups. Each group could leaf through the activities in the rest of the chapter and decide which one they wish to pursue. It will be interesting for you to see how the pupils make this decision. There may be implications for teaching some group interaction processes. (See *Examining Your Environment, An Introduction for Teachers* for more information on this aspect of teaching.)

Capitalize on pupils' questions arising out of the activity that has just been completed and guide the pupils to devise their own activities to answer their questions. The pupils will require a great deal of help when they first attempt to organiz their own investigations. Try to be patient and helpful, but hold them accountable for the skills that they have just learned.

ow to Use this Guide

h teacher's guide corresponds to a book in the *Examining Your Environment* series. ry activity is analysed under several headings. When using the guidebooks, you uld first read the activity in the text, as this background will help you under- nd the references under these headings.

E

estimated time needed to complete the activity under normal circumstances is stated er this heading.

SON

er this heading, the most suitable seasons for carrying out the activity are con- ered. Whether the activity is to take place indoors or outdoors is also indicated.

SS ORGANIZATION

e, hints are given as to the ideal numbers of pupils that could perform an activity. s does not mean that more than one group could not try the same activity, if this is ctical. Some activities are recommended for the whole class; other activities, for ller groups.

IPMENT AND MATERIALS

ted here are the majority of the items that will be required for each group to carry the activity.

LS AND TECHNIQUES

column lists the main skills and techniques a student will need to carry out an vity. These items could form the instructional objectives for the activity and be criteria for most of the evaluation to follow. The information under this heading ides insight into items that may require preteaching or review.

EPTS

result of completing the activities, the child should have gained some general ledge. Only the major concepts have been listed. Often, they have been expressed eneral terms and may be oversimplified.

ESTIONS FOR VALUE TEACHING

r this heading you will find value clarification statements or questions that you d use to guide the students to determine what the activity means to them. Of se, you will, no doubt, have your own ideas as to the type of exercises that will urage your students to gain greater meaning from their studies, and you should your thoughts to augment the suggested ones.

CLUES TO QUESTIONS

Because the answers often relate directly to the data collected, many of the answers to the questions in the *Digging Deeper* sections will depend upon the circumstances. Some of the factors that might be considered in answering a question have been listed

TROUBLE SHOOTING

Under this heading is a checklist of items that are useful in guiding pupils during the activity. Some of these items may account for the success or failure of an activi

VOCABULARY

Under this heading, you will find words which the students should know beforehand or which they should be able to add to their vocabularies after completing the activity.

RESOURCES

Both the text and the bibliography contain suggestions for obtaining special materials when they are required. Under this heading are listed *other* possible sources of ideas and supplies.

CROSS REFERENCES

When a skill or piece of apparatus has been employed in a different book of the *Examining Your Environment* series, reference to the activity is made. This will be useful to the teacher who wants students to further develop particular skills through another similar activity.

1. THE TURNING OF A TAP

tivity 1:
t is the pathway of water in a build-
g?

E
45-minute periods
first period should be used to make
ervations and measurements and record
gh data, and the second to make a
al record of the discoveries.

SON
time indoors

SS ORGANIZATION
ll groups or individuals

IPMENT AND MATERIALS
each group:
ting materials
ored pencils
ers
suring tapes
ipers

LLS AND TECHNIQUES
- organizing work individually or in
ups
- estimating and measuring length and
meter of water pipes
- sketching a plumbing system
- interviewing to obtain specific
rmation

CEPTS
plumbing in a building is usually
anged to keep the number of pipes to
inimum.
water faucets are usually on the
t side and cold water faucets on the
ht side.
e water pipes have a larger diameter
fresh water pipes.
r traps and vents prevent sewer
s from entering houses.

SUGGESTIONS FOR VALUE TEACHING

The water pathway in a house has been carefully designed to provide clean, safe water and to discharge dirty, waste water without having the two come into contact with each other. Why is it important that so much planning and careful work should be put into the plumbing system of a building? Explain your answer.

CLUES TO QUESTIONS

Since waste water pipes must carry many types of liquids and debris, they have larger diameters to prevent blockages. The design of the hot water system is usually made as efficient as possible, not only to reduce the cost of materials, but to conserve heat.

Bathrooms are often situated directly above or beside kitchens to keep piping to a minimum.

TROUBLE SHOOTING

- Answers to questions can best be obtained by pupils working in groups of three or four, with each pupil doing specific tasks, such as measuring or recording data.
- Some of the pipes will be hidden or quite inaccessible. The pupils will have to infer in some instances what the unseen pipes are like.
- Care must be taken that pupils observe the different loops, bends, and slants of the pipes.
- Responsibilities and procedures must be established before groups of pupils attempt the activity.
- Garden hose connections or sprinkler systems must not be forgotten when listing water outlets.

VOCABULARY

diameter
vent
plumbing system
faucet

RESOURCES

The school custodian, parents, or the local plumber can be of assistance.

Branching Out:
Waterworks; sewage treatment; septic systems.

TIME

three 30-minute periods and two half-day trips

The first period should be used to interview the city engineer, the second to interview a builder who installs septic systems, and a third to interview a homeowner who has a septic system.

Half-day trips are needed to visit the local waterworks and a sewage treatment plant.

SEASON

anytime but best in spring, summer or autumn

CLASS ORGANIZATION

small groups or individuals

The visits to the waterworks and sewage treatment plant should involve the entire class.

EQUIPMENT AND MATERIALS

For each group:
writing materials
maps of the municipality
tape recorder

SKILLS AND TECHNIQUES

- interviewing to obtain specific information
- using a tape recorder
- making notes in an out-of-school learning situation
- preparing a detailed set of questions and procedures prior to an activity

CONCEPTS

Most municipalities rely on local rivers, streams, lakes, or wells for the water supply.

Usually the water supply is impure and must be treated before it can be safely used.

Sewage must be carefully treated to avoid or reduce pollution.

Municipalities often have complex sewage treatment plants.

Individual homeowners can install systems to treat sewage from their own homes.

Septic tanks provide an environment wher certain bacteria thrive and do useful work in treating sewage.

On a hot, humid day, water in the air condenses on the surface of cold objects

SUGGESTIONS FOR VALUE TEACHING

A great deal of effort is made to provide safe water and to treat waste water. Is this effort really worthwhile?

Carefully considered laws and regulations govern the treatment of sewage in many areas. Can you explain why?

Each person requires a large amount of fresh water daily. The availability of a constant water supply cannot be guaranteed. Why?

A reliable indoor water supply is a great convenience. How would your life be different if safe water were not available?

CLUES TO QUESTIONS

An impure water supply requires special treatment and may go through many different processes. Pupils may appreciate more the reasons for these processes following a discussion of the impurities that are often present, such as solid debris, dissolved gases, chemicals, bacteria, algae, plant life, and so on. A discussion of pupils' suggestions for removing these impurities could follow. Pupils may be guided towards an understanding of how a septic tank works by discussing the various ways in which breakdown takes place in nature. Starting points might be: milk turning sour, growth of molds, fungus growth on decaying vegetable matter, rotten eggs, or compost heaps.

TROUBLE SHOOTING

- The interviews and visits should be preceded by careful preparation of specific questions, practice in interviewing skills and allocation of responsibilities.
- Obtain maps that are sufficiently large and clear so that the water systems can be marked on easily.

VOCABULARY

septic system
municipality
waterworks
contractor
purify
sewage
humid

SOURCES
ty hall, sewage treatment plant,
cal waterworks, and local building
ntractors could all be of assistance.

SS REFERENCES
llution, pages 42, 49 and 50, 56 to 60,
and 64, 73 to 76.

re Branching Out:
water meter; the toilet; the con-
ience of a plumbing system.

ME
ree 10-minute periods
first period to read the school water
ter; the second to examine a toilet
nk; and the third to discuss plumbing
stems.

SON
ytime indoors

SS ORGANIZATION
ll groups or individuals
activities could also be carried
t at home.

UIPMENT AND MATERIALS
each group:
ting materials
ter bills or examples on page 6 of the
t
grams on page 7 of the text

LLS AND TECHNIQUES
- conducting an investigation to
wer specific questions
- reading and understanding a water
ter

NCEPTS
ter meters measure the volume of water
sing through them in either gallons
cubic feet.
lush toilet tank works on a system of
ves and water pressure.

GGESTIONS FOR VALUE TEACHING
Paying for the amount of water you
may help to make you more careful.
it necessary to conserve water?

Most people take it for granted that they will have continual supplies of water. What activities around the house would be more difficult if you had to pump all the water you used?

CLUES TO QUESTIONS
The concept of economies of scale might help to explain why the cost of water per unit is reduced when more is used. Apart from labor costs for installing and maintaining water supplies, the distances involved and the number of houses in a new subdivision are factors to be taken into consideration. The pupils should include such questions in their interview with the city engineer. Pupils could be encouraged to learn how a ball cock floats by floating objects of different sizes, shapes, and densities in a bowl of water.

TROUBLE SHOOTING
- Collect enough schedules of monthly payments and water bills to supply pupils who cannot obtain their own.

VOCABULARY
water meter
discount
consumption
flat rate
ball cock
float valve
trip lever
float rod
flush tank ball
float tank ball

RESOURCES
Parents or the local municipal offices could help by providing water rate bills and schedules.

Activity 2:
What is a tap?

TIME
45 minutes

SEASON
anytime indoors

CLASS ORGANIZATION
small groups seated around a table or desk

EQUIPMENT AND MATERIALS
For each group:
old tap
screwdriver
open-end or monkey wrench
length of garden hose
hose clamp
labelling tabs

SKILLS AND TECHNIQUES

- using small hand tools properly
- labelling accurately

CONCEPTS
Taps are designed to provide a ready supply of water when required, with a minimum of effort and with no needless waste of water.

SUGGESTIONS FOR VALUE TEACHING

What do you think might be the result if a great many people were careless about leaking taps and wasting water?

CLUES TO QUESTIONS
Encourage pupils to think of as many different types of taps as possible. Apart from ordinary water taps, they could discuss taps on barrels of oil, gas taps in the laboratory, and so on, and how they all work on the same basic principles.

TROUBLE SHOOTING

- Ask local plumbing suppliers for a variety of used taps. Penetrating oil may be used to loosen seized parts.
- To test the reassembled taps it may be necessary to solder a length of copper pipe to the tap so that it can be connected to a hose.
- If insufficient taps or hose connections are available, groups can take turns taking apart and reassembling taps.
- If pupils can bring tools from home, they should be carefully labelled so that the owners can more readily claim them at the conclusion of the activity.

VOCABULARY
faucet
valve
spout
washer
seat

RESOURCES
A local plumbing supplier could be of assistance.

Branching Out:
Fixing faucets.

TIME
1 hour

SEASON
anytime indoors

CLASS ORGANIZATION
groups of two or three

EQUIPMENT AND MATERIALS
For each group:
old tap
screwdriver
wrenches
extra washers and packing

SKILLS AND TECHNIQUES

- using small tools with reasonable competence
- inferring water wastage
- measuring liquids

CONCEPTS
Properly maintained taps do not waste water.
Most leaking taps can be repaired easily

SUGGESTIONS FOR VALUE TEACHING

It is easy to waste water because o leaking taps, but it is also very easy t repair a leaking tap and to take a little extra care not to leave taps dripping. On the scale line below place an "x" to sho what your habits have been in the past and place a "y" to show how you will use taps in the future.

Leaky Louise leaves taps dripping.	Fix-it Freddy makes sure that taps are turned off and tries to fix leaking taps.

1 2 3 4 5 6 7 8 9 10

LUES TO QUESTIONS
ave an estimate of the number of house-
olds in the city to estimate how much
ater might be wasted.
upils might appreciate the value of
urn-off valves after discussion of
rozen pipes, leaks, burst pipes, and
o on, and the damage this can cause.

ROUBLE SHOOTING
●Investigate local plumbing suppliers
or used taps and parts.
●Provide a variety of washers to show
he importance of having the right one
or the tap.
●A catalogue from a local plumbing
upplier might help to illustrate a
ariety of taps if they are not readily
vailable.

OCABULARY
ompression tap
rass friction ring
urn-off valve
ap bonnet packing
op bibb washer
ibb screw
oneslip joint washer

ESOURCES
local plumbing supplier could be of
ssistance.

tivity 3:
w are pipes different?

IME
wo 45-minute periods

EASON
ytime indoors

LASS ORGANIZATION
all groups to examine and measure
ipes both in and outside the classroom
ut-of-classroom investigations can be
ssigned as homework over a number of
ays.

EQUIPMENT AND MATERIALS
For each group:
variety of pipes
calipers
rulers
national or continental maps
encyclopedia
writing materials

SKILLS AND TECHNIQUES
- measuring inner and outer diameters of pipes
- using calipers
- measuring length
- recording information in chart form
- reading maps

CONCEPTS
Pipes are made of many different materials.
The material of which a pipe is made is determined by the use for which it is intended.
Pipes vary in thickness.
Copper piping is commonly used in homes.
Old iron pipes sometimes become clogged with calcium deposits from hard water.
Pipes carry many liquids other than water.
Lead poisoning can result if lead comes in contact with drinking water.
Copper piping is being replaced by synthetic materials because of high cost and the limited supply of copper.

SUGGESTIONS FOR VALUE TEACHING

Why are copper pipes rarely used in the building of new homes? Why is it important that people continually find new ways for doing the same thing?

What are the advantages and disadvantages of oil and gas pipelines for carrying these commodities over long distances?

CLUES TO QUESTIONS
The difference between inside and outside diameters of pipes should be made clear.
The difference between "hard" and "soft" water should be discussed.
The pupils should be challenged to search for a wide variety of pipes.

TROUBLE SHOOTING

- There may be some difficulty in measuring the thickness of thin pipes. The pupils should be taught how to use calipers before attempting this activity.
- If a large variety of pipes is not available, a local plumbing contractor may loan or donate a variety of scrap pipes to the class.

VOCABULARY

diameter
hard water
soft water

RESOURCES

A local plumbing supplier and building contractor could be of assistance. The local library or school library should be used for additional information on gas and pipe lines and Roman water distribution systems.

CROSS REFERENCES

Snow and Ice, page 50.

Activity 4:
How does the pressure (force of water) coming from a tap vary?

TIME

one 45-minute period and two half-day trips (a visit to a pumping station and a water tower)

SEASON

outdoors on a pleasant day

CLASS ORGANIZATION

This activity is best done by small groups in a pupil's own backyard.
The entire class should visit a pumping station and a water tower.

EQUIPMENT AND MATERIALS

For each group:
hose with nozzle
writing materials
measuring tape
quart-sized oil cans
hammer
nails

SKILLS AND TECHNIQUES

- measuring length
- graphing collected data
- using simple hand tools

CONCEPTS

The pressure of water coming from a tap decreases as additional taps are turned on.
Water pressure increases with the height of the water level above a tap or opening.
Water pressure is equal in openings at the same height in a column of water.

SUGGESTIONS FOR VALUE TEACHING

During hot, dry summer months, homeowners in towns and cities sometimes are asked to limit the watering of lawns to certain hours or days. Is this fair? Should people cooperate? Explain your answer.

CLUES TO QUESTIONS

The pupils should be encouraged to speculate on the results before they attempt a new step in the activity.

TROUBLE SHOOTING

- The steps of the activity should be carefully explained in the classroom before the pupils begin.
- The hose must be held in a constant position to measure the distance water travels. The hose can be tied to a chair to maintain a constant position if undue difficulties arise.
- The oil cans should be thoroughly cleaned before use and large enough nails should be used to enable them to be removed easily.
- Check all connections before allowing the pupils to turn on the taps.

VOCABULARY

nozzle
pressure
parallel
reservoir
horizontal
clockwise
counterclockwise
water tower
pumping station

RESOURCES

The local water pumping station and local water tower could be visited and the supervisors interviewed.

tivity 5:
at can we learn about fire hydrants?

ME
hour

ASON
ytime outdoors

ASS ORGANIZATION
ll groups in vicinity of the school
d/or entire class observing a demon-
ration by someone from the local fire
partment

UIPMENT AND MATERIALS
r each group:
lers
lipers
re hydrants
re extinguisher
iting material

ILLS AND TECHNIQUES
- conducting an interview to obtain
ecific information
- rephrasing questions if the answers
ven by the firemen are confusing
- recording data

NCEPTS
re hydrants are painted bright colors
that they are clearly visible.
re hydrants are connected to the
nicipal water supply.
re hydrants are spaced so that all
ildings can be serviced by a fire
uck.
oximity to fire hydrants usually
duces house insurance.

GGESTIONS FOR VALUE TEACHING
Why should fire hydrants be easily
cessible to firemen and clearly visible
all times? How can you help in this
tter?
Have the students role-play the fol-
ing situation after the activity has
n completed: *Two friends are driving*
ng a city street and decide to visit
of the stores. Since they will not
there for very long the driver
ides to park beside a fire hydrant
this is the only available parking
t. When the friends come out of the
re they see that a policeman is
placing a ticket on their car. The driver is quite upset and a discussion follows. The students who are chosen to play the roles should have an opportunity to plan what they are going to say.

CLUES TO QUESTIONS
Questions well prepared in advance of an interview with a fireman will produce better responses.
The pupils should be taught the techniques of interviewing and even practise interviewing each other before the appointment with the fireman.

TROUBLE SHOOTING
- A variety of different fire hydrants and extinguishers should be examined and compared. If they are not available, at least pictures should be examined.
- Someone knowledgeable about hydrants and extinguishers should be available to help the pupils in their investigations.

VOCABULARY
hydrant
extinguisher
insurance rates

RESOURCES
A local fireman and/or fire insurance agent could be interviewed.

2. SPRINKLERS, HOSES AND NOZZLES

Activity 1:
In what ways are garden hoses different?

TIME
45 minutes

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION
small groups in the school grounds
(Other sources may be investigated after school hours.)

EQUIPMENT AND MATERIALS
For each group:
variety of garden hoses
writing materials
calipers
measuring tape

SKILLS AND TECHNIQUES
- recording data on a chart
- measuring length
- measuring inside and outside diameters of hoses

conducting an interview successfully to obtain information

CONCEPTS
Garden hoses have different inside diameters.
Garden hoses are made of different materials.
Garden hoses are made in various lengths
A hose is a flexible pipe used to carry water from one point to another for a relatively short period of time.
Two or more hoses can be connected quite easily to make a longer hose.

SUGGESTIONS FOR VALUE TEACHING

Do you think that the more expensive hoses are better than the cheaper ones? Why?

Are the old rubber hoses less efficient than newer plastic ones? Why do you think most garden hoses are made of synthetic materials today?

CLUES TO QUESTIONS
A local hardware store owner might be able to help the pupils answer these questions and even supply a catalogue listing various types of hoses and their prices.

TROUBLE SHOOTING
- It is best to avoid examining the garden hoses during cold winter weather because many hoses become quite stiff and difficult to handle at low temperatures.
- The hoses can best be examined on the school grounds where they can be unwound.
- Groups of students can move from one hose to another to make observations and measurements.
- It might be useful to keep a list of different kinds of hoses other than garden hoses that students can investigate out of school shours.

VOCABULARY
flexibility
irrigate
diameter

RESOURCES
A local hardware store, gas station, and fire department could all be visited and personnel interviewed.

Activity 2:
How does the inside diameter of a hose affect the quantity of water that can pass through it?

TIME
20 minutes for class organization
45 minutes for activity
25 minutes to follow-up

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION
small groups
Details of the activity can be carefully organized in the classroom but the activity can best be done at the homes of the pupils after school hours. The results can be examined later in the classroom.

QUIPMENT AND MATERIALS

r each group:

topwatch or a watch with a sweep second hand
ail
easuring cup
riting materials

KILLS AND TECHNIQUES

- timing an event accurately using a topwatch or a watch with a sweep second and
- recording and plotting data on a raph
- interpreting and extrapolating nformation on a graph
- measuring the volume of liquids

ONCEPTS

he larger the inside diameter of a hose, he greater the quantity of water that an pass through it.

UGGESTIONS FOR VALUE TEACHING

Why do you think a fire hose has a arger diameter than a garden hose? Why s it so important to have special con- ections for fire hoses?

LUES TO QUESTIONS

he mathematics program can be correlated ith the science program to strengthen kills in graphing, measuring, inter- reting, averaging, and timing.

ROUBLE SHOOTING

- Each group of pupils should work ith at least three hoses with different iameters, to obtain sufficient data.
- Pupils should practise timing events efore they attempt this activity until hey achieve a reasonable level of ompetence.
- If the pupils are unskilled in nterpreting graphs, some additional time hould be allowed to learn this skill.
- Check all connections before letting upils turn on the taps.

OCABULARY

topwatch

ESOURCES

local fireman could be interviewed.

Activity 3:
What affects the force of water coming from a nozzle?

TIME

20 minutes to plan activity in the classroom
45 minutes to construct the device to measure water force in the classroom or at home
45 minutes to conduct the activity in the school ground or backyard of a home
25 minutes to evaluate the results in the classroom

SEASON

outdoors in spring, summer or autumn

CLASS ORGANIZATION

small groups of four or five

EQUIPMENT AND MATERIALS

For each group:

garden hose with nozzle
a flap device to measure the force of water
writing materials

SKILLS AND TECHNIQUES

- recording and plotting data on a graph
- measuring distance accurately
- using small hand tools competently
- using the measuring device for water pressure properly

CONCEPTS

The closer the nozzle is to the flap, the greater the pressure of water.
A hard, concentrated stream of water has greater force than a gently dispersed stream of water.

SUGGESTIONS FOR VALUE TEACHING

Study the photograph on page 17. Are the children using a good nozzle to water the garden? Explain your answer.

CLUES TO QUESTIONS

Some of the factors affecting the force of water flowing from a nozzle are: distance, angle of watering, adjustment of nozzle opening, water pressure from the tap, and diameter of hose.

TROUBLE SHOOTING

•The device for measuring water force must be securely anchored with rocks or other heavy materials so that it is not knocked over.

•The device can be made at home by some pupils after it has been thoroughly discussed in the classroom. Ideally it should be made in the classroom, and should be tested before being used to make certain that it swings freely.

•The pupils should practice aiming the hose accurately before readings are taken.

VOCABULARY

area
water cannon
maximum
evidence

RESOURCES

The school or local library would be a good source of information on the use of high pressure hoses in mining and water cannons.

Activity 4:
In what different ways do lawn sprinklers spread water?

TIME

45 minutes

SEASON

outdoors in spring, summer or autumn

CLASS ORGANIZATION

class should work as a unit to observe the sprinklers operating on the school lawn

EQUIPMENT AND MATERIALS

variety of lawn sprinklers
garden hose
writing materials

SKILLS AND TECHNIQUES

- observing carefully
- drawing sketches for records

CONCEPTS

Different lawn sprinklers distribute water in a variety of ways to meet specific needs.

SUGGESTIONS FOR VALUE TEACHING

Why are some sprinklers better for some areas than others? Are some doing a much harm as good to the plants? Are some very wasteful of water?

CLUES TO QUESTIONS

Observations and discussion will provide many clues to and understanding of how different sprinklers work to distribute water.

Some old sprinklers may be obtained to take apart. The pupils, having observed the working parts, will be able to infer how each sprinkler operates.

The ensuing discussion might center on making comparisons of how different sprinklers work.

TROUBLE SHOOTING

•Since the primary activity is observation, the entire class can observe the operation of sprinklers at one time. This reduces the number of sprinklers that need to be acquired.

•Try to conduct this activity on well-drained ground that will not become muddy too quickly.

VOCABULARY

sprinkler

RESOURCES

A local hardware store could be of assistance.

Activity 5:
How large a surface does a lawn sprinkler water?

TIME

45 minutes

SEASON

outdoors in spring, summer or autumn

SS ORGANIZATION

e entire class should observe the
rinklers on the school lawn.
fferent groups of pupils could be
signed to each sprinkler and could do
e activity for that sprinkler while
e remainder of the class observed and
d the mathematical calculations.
oups of pupils could be encouraged to
peat the activity at home and compare
sults.

UIPMENT AND MATERIALS

riety of lawn sprinklers
iting materials
icks or large stones
rden hose
asuring tape

ILLS AND TECHNIQUES

- measuring distance
- calculating the area of a rectangle
d of a circle
- making scale drawings

NCEPTS

h variety of lawn sprinkler is designed
cover a particular amount of lawn sur-
e from one position.
area of a lawn that a sprinkler covers
be controlled by adjusting the amount
t the tap is turned on.

GESTIONS FOR VALUE TEACHING

During this activity each pupil or
up of pupils had a particular task to
form. Some operated the sprinklers;
e marked the areas watered by each
inkler; others observed and calculated
mathematics necessary for the activ-
. Everyone contributed something to
successful completion of the investi-
ion. Was it necessary to involve the
le class? What responsibility did each
ber of the class have? Would you
fer to work in this way, in small
ups or individually? Explain your
wer.

UES TO QUESTIONS

separate activity could be set up to
st how much water comes from different
rinklers.
ain this program can be linked with
e math program in calculating the area
vered by the sprinklers.

TROUBLE SHOOTING

- It will help to ensure that pupils know how to calculate the area of a rectangle and a circle.
- An explanation of how to make scale drawings before beginning the activity will also help.
- One tap and hose should be used all the time to keep the water flow reasonably constant.
- For pupils who have not been taught to calculate area in mathematics, the area can be determined by counting the squares on the graph paper that represent the surface of the ground covered by the sprinkler. Pupils who have been taught how to calculate area can probably determine the area covered by each sprinkler mathematically.

VOCABULARY

radius

CROSS REFERENCES

Mini-climates, pages 24 to 27 (for *Branching Out* activity).

Branching Out:
Making a rain gauge.

TIME

half-day to visit a golf course
30 minutes to construct a rain gauge

SEASON

in spring, summer or autumn when the gauge can be used outdoors

CLASS ORGANIZATION

entire class for trip to a golf course
small groups of three or four to construct the rain gauge

EQUIPMENT AND MATERIALS

For each group:
tobacco cans or any can with straight sides and completely open top
tall narrow bottles
toothpicks
rulers
masking tape
writing materials

SKILLS AND TECHNIQUES

- measuring accurately
- recording data over a period of days or weeks

CONCEPTS
Watering a lawn occasionally to a considerable depth is much preferable to frequent light sprinklings.
It is easier to measure a very small quantity of water in a tall, narrow vessel, but easier to collect it in a wide, shallow vessel.

SUGGESTIONS FOR VALUE TEACHING

Some experiments take a long time, as they have to be conducted over a period of days or weeks and results recorded to see trends. Is it worth the long wait to get the results?

TROUBLE SHOOTING

- It is better to make the rain gauge in spring or autumn when there is more likely to be a measurable rainfall.

VOCABULARY
rain gauge
masking tape
disperse

RESOURCES
The school or local library could provide information about irrigation of farm crops.

CROSS REFERENCES
Mini-climates, pages 25 to 27.

Activity 6:
How evenly does a sprinkler spread water?

TIME
45 minutes

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION
small groups of three or four

EQUIPMENT AND MATERIALS
For each group:
rain gauges made in previous activity
water sprinkler
garden hose
writing materials

SKILLS AND TECHNIQUES

- using a rain guage as a measuring device
- recording data on a map
- drawing a map using scale, directionals, symbols and title

CONCEPTS
Lawn sprinklers do not distribute water to all areas in exactly equal quantities. A number of factors such as sprinkler design, water pressure, wind, slope of ground, and so on, can contribute to the uneven distribution of water. (See photos on pages 22 to 25.)
Some lawn sprinklers distribute water more evenly than others.

SUGGESTIONS FOR VALUE TEACHING

Measuring things such as the amount of water sprinkled on a lawn can be either qualitative (a little, much) or quantitative (a precise measurement). This activity has guided you to be quantitative by requiring that you use rain gauges as measuring devices. This involves considerable work in preparing for and conducting the activity. Is it better to be quantitative or qualitative in your measurements? Explain your answer

CLUES TO QUESTIONS
Only rarely will all of the tobacco cans collect exactly the same amount of water.
The pattern of the sprinkled water will be unique to each sprinkler and the conditions under which the watering is done. Water pressure, wind conditions, and the sprinkler design will all have an effect.
Results will differ over a period of time if any one or all of the conditions change.

TROUBLE SHOOTING

- Pupils should practise using the rain gauge until reasonably competent.
- The more cans that are used to collect the water the better will be the activity. Try various ways of placing the cans so that all areas covered by the sprinkler get a fair representation.

CABULARY
stribution

OSS REFERENCES
ni-climates, pages 25 to 27.
pping Small Places, Chapter 2.

anching Out:
king a raindrop collector.

ME
minutes

ASON
tdoors in spring, summer or autumn

ASS ORGANIZATION
all groups of three or four

UIPMENT AND MATERIALS
r each group:
oe box lid
fted flour
ler
our sifter
wn sprinkler

ILLS AND TECHNIQUES
- measuring accurately

NCEPTS
e size of drops of water varies.
is possible to determine fairly
curately the size of drops of water
om a sprinkler or a rainstorm.

GGESTIONS FOR VALUE TEACHING
Meteorologists keep valuable weather
ecords. How do you think they might use
indrop collectors? How would this help
em to predict the weather?

OUBLE SHOOTING
- Be careful that the flour is well
ifted.
- The pellets should be left two or
ree days to become hard before sift-
ng.

OCABULARY
indrop collector
lour sifter
llet

Activity 7:
How does the size of water droplets produced by different sprinklers compare?

TIME
20 minutes to collect water drops from lawn sprinklers
45 minutes to sort out the pellets, to mount them, and to make comparisons

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION
small groups to collect water droplets on the school lawn and to sort pellets in the classroom.
Each group should conduct the activity independently until it is time to discuss the *Digging Deeper* questions as a whole class.

EQUIPMENT AND MATERIALS
For each group:
raindrop collectors made in the previous activity
lawn sprinklers
garden hose
Scotch tape
writing materials

SKILLS AND TECHNIQUES
- sorting and ordering according to size
- using a raindrop collector skillfully

CONCEPTS
Each type of lawn sprinkler produces water droplets that vary in size. Some lawn sprinklers produce predominantly small water droplets and others produce mostly larger water droplets.

SUGGESTIONS FOR VALUE TEACHING
Discuss the damage that can be done to new seeds by using the average sort of sprinkler and to farmers' crops by heavy rainstorms.

CLUES TO QUESTIONS
The sprinkler that produces the finest spray should be used to sprinkle a newly-seeded lawn so that the seeds will not be unduly disturbed.
The size of raindrops in light showers and heavy rainstorms will vary as much as that from different sprinklers.

TROUBLE SHOOTING

- Pupils should practise with the raindrop collector to gain experience at obtaining a good sampling. Too many water drops will create a sticky, doughy mass rather than round pellets.
- The pellets should be left for several days to dry out and harden before they are sorted.

CROSS REFERENCES

Mini-climates pages 30 to 31.

Activity 8:
Is the ground under a bush as wet as the ground in an open lawn after watering?

TIME

20 minutes to set up the activity
1 hour to water the area
1 hour to measure the water, dig at various points in the lawn, record data and consider the results.

SEASON

outdoors in spring, summer or autumn

CLASS ORGANIZATION

entire class with a small group responsible for each tobacco can that is used

EQUIPMENT AND MATERIALS

lawn sprinkler
several tobacco cans
hand trowel
rulers
writing materials

SKILLS AND TECHNIQUES

- using a rain gauge
- recording data

CONCEPTS

The climate under a bush can be very much like a desert.
Plant life under dense shrubs is often scarce because of the small amount of rainfall that reaches the ground and because little sunlight reaches the ground.

SUGGESTIONS FOR VALUE TEACHING

Why do you think that sprinkling th lawn in this chapter was often compared to rainfall conditions? Scientists use the technique of a clinical study under controlled conditions to find answers to their problems. Do you think that by using sprinklers rather than rainfall yo were working as a scientist might?

CLUES TO QUESTIONS

Many shrubs have shapes that cause water to drip along the outside edge of them. Also the dense foliage allows little water to penetrate to the inside of the bush. As a result water is diverted to the ground along the outside edge of the bush, leaving the area underneath dry and desert-like.
The results should be the same under rainfall conditions as when sprinkling the lawn.

TROUBLE SHOOTING

- An adequate number of water collecting cans should be used to get the best indication of the extent to which shrubs and bushes prevent rainfall from reaching the ground.
- Permission should be obtained before digging into lawns and the lawn should be left in as good a condition as it was found.

VOCABULARY

evergreen shrubs
penetrate
abundant

CROSS REFERENCES

Mini-climates, pages 24 to 27.

. SLOPES, GRADES AND GUTTERS

tivity 1:
ere are eaves troughs (gutters) located
buildings?

IME
hour

ASON
ytime indoors

ASS ORGANIZATION
dividuals selecting a building of their
n choice to sketch

UIPMENT AND MATERIALS
r each pupil:
iting materials

ILLS AND TECHNIQUES
- sketching with reasonable accuracy
- making valid comparisons
- interviewing successfully
- recognizing cause-and-effect
lationships

NCEPTS
st buildings such as houses have eaves
oughs to carry away rainfall.
ves troughs are located wherever water
able to run down a roof surface.
ves troughs prevent rainfall from
ipping from roofs onto bare ground or
ere people walk.
me houses have very unusual arrangements
eaves troughs.

GGESTIONS FOR VALUE TEACHING
Most eaves trough systems are
signed simply to carry away rainwater
a safe manner. Can you redesign the
ves trough system on the building that
u sketched so that the run-off water
uld serve a practical purpose?

UES TO QUESTIONS
scussion will produce better understand-
g of why eaves troughs are located in
rticular positions.
pils who investigate the *Branching Out*
ction will gain a greater insight into
ves trough systems.

TROUBLE SHOOTING
- Pupils should select fairly simple, single-storey buildings.
- Pupils should make drawings of all sides of the building if possible.
- It might be necessary to teach pupils something of perspective in drawing before this activity.

VOCABULARY
flashings
eaves trough
downspout
phenomenon
water cycle
run-off

RESOURCES
A local hardware store or building contractor could be of help in providing different types of eaves troughs and discussing how different systems work.

CROSS REFERENCES
Snow and Ice, pages 47 to 49.

Activity 2:
How are eaves troughs placed in order to speed the flow of water?

TIME
1 hour

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION
groups of two or three

EQUIPMENT AND MATERIALS
For each group:
carpenter's level
ladder
pail of water
measuring tape
writing materials

SKILLS AND TECHNIQUES
- using a carpenter's level
- sketching with some competence
- calculating area and volume (*Branching Out* section)

CONCEPTS

Eaves troughs are placed so that water can run off easily.
Eaves troughs that do not drain properly can become a breeding ground for mosquitoes.
Defective eaves troughs can damage or deface buildings.
Eaves troughs that do not drain properly will deteriorate quite quickly.

SUGGESTIONS FOR VALUE TEACHING

You and your classmates have studied the eaves trough systems of several buildings in your neighborhood. Perhaps the eaves troughs have not been inspected by their owners. From your observations of the condition of the eaves troughs make a list of suggestions that you could make to the owner to help him take better care of his eaves troughs.

CLUES TO QUESTIONS

Only if the bubble in the carpenter's level is between the two lines is the surface level. If the bubble is on one side of the lines, the surface slopes downward to the other side. If the eaves troughs were improperly slanted, the water could accumulate away from the downspout, stagnating there and possibly overflowing in heavy storms.

TROUBLE SHOOTING

- If a ladder is used it should be safely steadied by pupils.
- Make sure that the eaves troughs and downspouts are not blocked before pupils start this activity.

VOCABULARY

cistern
dry well
carpenter's level
debris
durability

RESOURCES

A local architect or building contractor could be of help in discussing how houses are planned for proper water run-off.

CROSS REFERENCES

Mapping Small Places, pages 44 to 45.

Activity 3:
Do cars have eaves troughs?

TIME

30 minutes

SEASON

anytime outdoors

CLASS ORGANIZATION

short class excursion to the staff parking lot and to cars parked along the roadside

EQUIPMENT AND MATERIALS

For each pupil:
writing materials

SKILLS AND TECHNIQUES

- observing carefully and identifying eaves troughs on cars

CONCEPTS

All cars have eaves troughs.
Eaves troughs on cars carry away run-off that could reduce vision from the side windows.
Eaves troughs are not needed for the front windshield of a car.

SUGGESTIONS FOR VALUE TEACHING

What might happen if the eaves troughs on a car were blocked? Which is more important -- the appearance of the car or its ability to function safely? What other safety points on a car can you think of?

TROUBLE SHOOTING

- A good sampling of cars and trucks should be observed.

RESOURCES

A local garage owner could be interviewed about different types of cars. An antique car museum could be visited or a book on antique cars studied.

Activity 4:
What differences can be found in the pitch or slope of the roofs of houses?

TIME

45 minutes to construct an angle finder
1 hour to examine roof slopes

ASON
ytime in spring, summer or autumn

ASS ORGANIZATION
oups of two or three to construct angle nder device and tour the school area observe and record roof slopes

UIPMENT AND MATERIALS
r each group:
ece of wood 25 cm x 25 mm x 20 mm
ece of wood 75 mm x 25 mm x 20 mm
rcular protractor
umbtack
ight, such as a large nut or nail
ring
inking straw
ue
iting materials

ILLS AND TECHNIQUES
- using simple hand tools competently
- using angle finding device accurately
- recording data
- using a protractor
- calculating averages

NCEPTS
e slope or pitch of roofs of various uses differs.
creased slope tends to protect shingles d roofs better than slight slopes.
eeper slopes are also better in areas heavy snowfall.

GGESTIONS FOR VALUE TEACHING
You have studied buildings of var-us ages, sizes and styles. What is ur preference in the style and quality house construction? Do you prefer der houses or new houses? Mark your oice on the scale line and be prepared explain your choice.

d-fashioned Modern
lie Millie

UES TO QUESTIONS
der houses usually have a greater pitch the roof than new houses.
pils who pursue the *Branching Out* ction will gain greater insights into e roof construction of various types buildings.

The *Branching Out* section could be linked with a geography program. Pupils could benefit from a discussion of how climate and availability of materials affect house design, especially roofs, in different parts of the world.

TROUBLE SHOOTING
- A good variety of different houses, both old and new, should be examined.
- Pupils should have sufficient practice with the angle finder before beginning the activity so that accurate measurements can be made.
- Three measurements of roof slopes should be taken and averaged.
- Precut the wood pieces for the angle finder to facilitate class organization when assembling the angle finders.
- Paper protractors can be duplicated and attached to cardboard for stability. (See *Mapping Small Places*, page 101, or *Astronomy*, page 91.)

VOCABULARY
roof pitch
angle finder
protractor
asphalt shingles
sighting arm

RESOURCES
A local roofing materials manufacturer could be consulted.

CROSS REFERENCES
Mapping Small Places, page 101.
Astronomy, page 91.

Activity 5:
Where are drains found?

TIME
45 minutes

SEASON
anytime indoors
outdoors in spring, summer or autumn

CLASS ORGANIZATION
groups of two or three

EQUIPMENT AND MATERIALS

For each group:
carpenter's level
measuring tape
marble or steel ball bearing

SKILLS AND TECHNIQUES

- using a carpenter's level
- measuring distances

CONCEPTS

Drains are lower than the surrounding area so that water can easily run into them.
Most basements have drains to carry off water.
Most large asphalted surfaces such as parking lots have drains.

SUGGESTIONS FOR VALUE TEACHING

In what places that you have not already examined would you expect to find drains? Why should they be in these places?

CLUES TO QUESTIONS

Investigate basements, parking lots, roadside gutters, concrete floors.

TROUBLE SHOOTING

- Check with the school caretaker before starting this activity.
- Make sure the marbles or ball bearings are large enough so they will not fall through the drain grids.

VOCABULARY

catch basin

RESOURCES

The school caretaker could be of help in tracing the drainage system of the school.

Activity 6:
How large an area is drained by a drain?

TIME

1 hour

SEASON

outdoors in spring, summer or autumn

CLASS ORGANIZATION

groups of six to eight around each drain that is being investigated

EQUIPMENT AND MATERIALS

For each group:
watering can or pail
water
chalk
writing materials
measuring tape

SKILLS AND TECHNIQUES

- observing carefully the flow of water to the drain
- drawing a scale map
- measuring distances

CONCEPTS

Poorly drained areas or improperly plac drains cause puddles to form.
Drains are not necessarily located at t center of an area, but at the lowest po

SUGGESTIONS FOR VALUE TEACHING

Discuss what would happen if drain in the basement, schoolyard, street, an so on, were not kept clean.

CLUES TO QUESTIONS

Again this activity could be linked wit a geography program by comparing drains to natural drainage systems, deserts, marshes, and so on.

TROUBLE SHOOTING

- The points from which water starts to run toward a drain can be marked wit chalk.
- Many points around a drain should b located and then joined with a chalk lin
- Pupils who need help in making a scale map will require instruction. *Mapping Small Places*, pages 9 to 17 and 20 to 42, contains activities to develop this skill.
- If this activity is carried out in the hallway or basement of the school, the custodian should be consulted first.

VOCABULARY

drainage
scale map

RESOURCES

The school caretaker or caretaker of any large building could again be of help.

CROSS REFERENCES

Mapping Small Places, pages 9 to 17, 20 to 42, and 50.

tivity 7:
w are road surfaces designed for good
ainage?

ME
minutes

ASON
tdoors in spring, summer or autumn

ASS ORGANIZATION
oups of four to six for each location
osen

UIPMENT AND MATERIALS
r each group:
iting materials
tring
ler

KILLS AND TECHNIQUES
- measuring accurately
- preparing a scale drawing

ONCEPTS
oads are designed to be higher at the
enter and to slope toward the gutters
o that puddles do not form.

UGGESTIONS FOR VALUE TEACHING
Since roads slope downward toward
he curbs to promote good drainage, much
nsightly refuse gathers in the gutters.
ften this debris blocks the drains. What
o you think should be done about this
ituation?

LUES TO QUESTIONS
e pupils should freely discuss their
bservations and compare their records.
iscuss why some roads have higher crowns
han others. Try to find roads in areas
here there are heavy rainfalls or large
ccumulations of water as well as in
rier areas to point up this difference.
pils should be encouraged either to
nterview the city engineer or to write
letter to his department at the muni-
ipal buildings for more information on
oad construction.

ROUBLE SHOOTING
- This activity should be carried out
n a street that is not very busy.
pils should be stationed to warn of
he approach of cars.
- Equipment should be gathered before the activity starts and the responsibilities of each pupil clearly defined.

VOCABULARY
crown of road
gutter
curb
intervals
promote

RESOURCES
The local city engineer or a road-building contractor could be interviewed.

CROSS REFERENCES
Mapping Small Places, pages 44 to 58.

Activity 8:
Where are catch basins (drains along the gutters of a street) located on the street?

TIME
1 hour

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION
groups of three or four
Each group could be assigned a section of road along a quiet street. Although the work should be done from the curb or sidewalk, each group should have one member whose job it is to watch for oncoming traffic and warn his group members to stand back.

EQUIPMENT AND MATERIALS
For each group:
writing materials
pails of water

SKILLS AND TECHNIQUES
- drawing maps complete with title, directionals and legends
- observing carefully the direction in which the water flows
- inferring the location of connecting pipes below the road
- inferring the use of manhole covers
- interviewing successfully

CONCEPTS

Catch basins are usually found at intersections, and often at intervals between intersections.

Roadbeds are graded so that water flows to the intersections.

Catch basins are connected to a system of storm sewers.

Roads can flood even when catch basins are present if the catch basins are clogged or if the rainfall is too heavy for the catch basins to drain the water.

A high point or "divide" is found somewhere between two adjacent catch basins.

SUGGESTIONS FOR VALUE TEACHING

"Our society depends upon man's ability to change his natural environment." How has the natural environment in your community been changed through road construction? In what ways have road construction projects been good or bad for your community?

If you could change road construction in your community what would you do? What would be the benefits of your changes?

If you really wanted to do something about the ways in which roads are built, what would your first steps be?

CLUES TO QUESTIONS

The city engineer can provide much information about local storm sewer systems. Carefully prepared questions should be organized before the interview.

TROUBLE SHOOTING

- Since pupils will be working in groups near roads, precautions should be taken to ensure safety. These precautions might include in-class safety instruction, a safety monitor for each group, supervision by the teacher and/or other adults.

VOCABULARY

catch basins
manhole covers
divide

RESOURCES

The city engineer could be interviewed about storm sewer systems and may provide maps or charts.

CROSS REFERENCES

Mapping Small Places, pages 44 to 58.

Activity 9:
What other efforts to promote good dra
can be found around the home and schoo

TIME

45 minutes

SEASON

outdoors in spring, summer or fall

CLASS ORGANIZATION

groups of two

EQUIPMENT AND MATERIALS

For each group:
carpenter's level
writing materials

SKILLS AND TECHNIQUES

- using a carpenter's level
- inferring the effects of good and bad drainage practices
- recording data

CONCEPTS

Window ledges, doorsills, driveways, an
various forms of landscaping are design
to carry water away from buildings.

SUGGESTIONS FOR VALUE TEACHING

Conduct the same activity at your
house. List all the instances of poor d
age practices. For each situation, what
would have to be done to correct the po
drainage? Are you willing to convince o
members of your family and work with th
on the drainage needs of your house to
prove it?

CLUES TO QUESTIONS

Poor drainage can cause damage to build

TROUBLE SHOOTING

- If enough carpenter's levels are n
available refer to *Mapping Small Places,*
pages 44 to 45, for a simple way to construct levels.

VOCABULARY

assumption
doorsills

RESOURCES

A local architect or building contracto
could be consulted on how to design buil
ings to promote good drainage.

CROSS REFERENCES

Mapping Small Places, pages 44 to 45.

4. MOVING THE EARTH

Activity 1:
How quickly do soils absorb water?

TIME
1 hour

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION
groups of three or four

EQUIPMENT AND MATERIALS
For each group:
writing materials
watch with sweep second hand
can opener
water
ruler

SKILLS AND TECHNIQUES
- controlling variables such as amount of water, rate of pouring, method of timing, and so on
- recording data in field notes such as charts
- constructing a bar graph
- using a watch with sweep second hand accurately

CONCEPTS
Sandy soil and rich soil with much humus absorb water quite quickly.
Hard-packed soil and heavy clay soil do not absorb water very quickly.
Soils that do not absorb water well can cause run-off.
Concrete and asphalt absorb practically no water.
The ability of a soil to absorb water is known as its porosity.

SUGGESTIONS FOR VALUE TEACHING
Some areas around your house such as asphalt yards and pavements do not absorb water and therefore cause run-off. However, you cannot do anything about these areas. Other areas around your house might have hard-packed soil which also causes run-off. What can you do to these areas of hard-packed soil so that they absorb water better, the drainage is improved, and run-off reduced?

CLUES TO QUESTIONS
Factors that contribute to the rapid absorption of water are loosely-packed soil, soil rich in humus, and soil with large particles such as sand.
Factors that hinder the rapid absorption of water are well-compacted soil, poor soil with little humus, and soil with small particles such as clay.
Pupils who conduct the *Branching Out* activity will further their knowledge of soil porosity.

TROUBLE SHOOTING
- It may not be possible to wait until the water in all the cans is absorbed. After a reasonable passage of time the water left in the cans can be noted and an estimate made of the time required for absorption to be completed.
- A wide variety of soils should be tested.
- Hard-packed soil can be created by trampling on it.
- Try to ensure that the soils all have roughly the same water content to begin with.

VOCABULARY
particles
topsoil
absorb
fertile
texture
ingredients
run-off
absorption
clay loam
erosion
porosity
population explosion

CROSS REFERENCES
Mini-climates, pages 73 to 75.

Activity 2:
How does the force of falling raindrops affect the soil?

TIME
15 minutes to construct splash pillars
15 minutes to place splash pillars in position
15 minutes to collect splash pillars after rainfall
20 minutes to answer the *Digging Deeper* questions

SEASON
outdoors in spring, summer or autumn

CLASS ORGANIZATION

This activity can be done as a home assignment since rainfalls are not too predictable.

An alternative approach is to organize this as a class activity, improvising the rainfall by using the same type of sprinkler in the three different locations. In this way groups of two or three pupils can place their splash pillars in one of the areas so that several records can be obtained for each area.

EQUIPMENT AND MATERIALS

For each group:

3 milk cartons
stones
elastic bands
white paper
magnetic compass

SKILLS AND TECHNIQUES

- constructing a splash pillar from a plan
- using a magnetic compass to determine directions
- measuring time intervals
- comparing papers from each splash pillar
- using record sheets from splash pillars to infer the answers to the questions in the *Digging Deeper* section

CONCEPTS

Rain can cause considerable splash erosion on bare soil. The degree of splash erosion is determined by the heaviness of the rainfall and the amount of surface cover on the soil.

SUGGESTIONS FOR VALUE TEACHING

What public properties in your community have large areas of bare soil? You might visit local parks, boulevards, school grounds and other similar places. If you believed that unnecessary bare ground is not good because of soil erosion and because it is unsightly, would you write a letter to your local councillor to express your concern?

CLUES TO QUESTIONS

Factors that affect the amount and height of the splash on the pillars include: type of soil, amount of ground cover, heaviness of rainfall, wind speed, direction in which each side of the pillar is facing.

Pupils who conduct the *Branching Out* section will gain a greater knowledge of soil erosion caused by rainfall.

TROUBLE SHOOTING

- The splash pillars should be positioned facing due north. The cardinal compass points should be marked on the paper surrounding the splash pillars.
- Do not leave the splash pillars in the rain too long. The paper may deteriorate or the mud splashings may wash off.
- Rainfall may not be available when needed. The activity can be made into a home assignment for the pupils or rainfall can be improvised by using lawn sprinklers.

VOCABULARY

splash pillar
anchor

CROSS REFERENCES

Mini-climates, pages 28 to 30.
The Dandelion, pages 39 to 40.

Activity 3:
How do sheet and gully erosion start?

TIME

1 hour

SEASON

outdoors in spring, summer or autumn

CLASS ORGANIZATION

groups of four or five working in the school grounds or in a home garden

EQUIPMENT AND MATERIALS

For each Group:

garden hose and nozzle or watering can
mound of garden soil, including stones and plant remains
writing materials

LLS AND TECHNIQUES

•observing patterns of absorption
run-off
•sketching "before and after"
grams to show cause and effect
•determining cause-and-effect rela-
nships

CEPTS

e soil particles are carried away by
er most easily.
greater the force and volume of
er, the larger the quantity and size
soil particles carried away.
lies are created very quickly in
as with much exposed soil.

GESTIONS FOR VALUE TEACHING

Role-play a meeting between a conser-
ionist and a construction company owner.
conservationist is concerned that the
nds of soil around the construction
es owned by the builder are not only
ightly but are also subject to severe
sion. The builder argues that the mounds
earth are a necessary part of his busi-
s. Each pupil who is selected to role-
y one party or the other should plan
eral points to his argument. Perhaps
s can be done by consulting with other
bers of the class for their ideas.
ring your role-playing try to see if
two parties can arrive at a reason-
le solution to the problem.

UES TO QUESTIONS

eet erosion occurs when thin layers
sheets of soil are gradually removed
om the whole surface of a field.
lly erosion occurs when water gathers
the little rivulets or streams which
t ditches in the soil.
fferent types of soil will cause
fferent discolorations. If pupils are
terested in this aspect of the activ-
, it could be expanded to discover
at causes these different colors.

OUBLE SHOOTING

•Water should not be directed at the
und of soil in a hard forceful manner
this would cause undesirable washout.
•The soil should include a mixture
loose particles, clay lumps, stones,
icks, and so on.
•The soil should be fairly dry to
art with, to emphasize the effect of
ter.

VOCABULARY

sheet erosion
gully erosion
discoloration
bird's-eye view

RESOURCES

A visit to a construction site could help the pupils understand gully erosion.

Activity 4(a):
How does plant cover affect erosion?

TIME

45 minutes to construct wooden boxes
45 minutes to conduct the activity
45 minutes to answer the *Digging Deeper* questions and to summarize the results

SEASON

outdoors in spring, summer or autumn

CLASS ORGANIZATION

groups of four or five
Each group could construct a pair of boxes and then decide which one of the five experiments (a, b, c, d, e) to conduct. Through presentations after the investigations have been completed, the pupils will learn about all five of the experiments. The teacher should help the pupils to summarize the findings.

EQUIPMENT AND MATERIALS

For each group:
2 wooden boxes 50 cm x 25 cm x 10 cm
watering can
water
2 large-mouthed bottles at least 1 litre in size
sod
soil
scissors
2 pieces of wood 2.5 cm thick
writing materials
filter paper
spout made from a tin can

SKILLS AND TECHNIQUES

- constructing boxes according to diagram
- conducting a controlled experiment
- measuring exact quantities of water
- filtering water properly
- recording data

CONCEPTS

A cover crop such as grass greatly reduces erosion.

SUGGESTIONS FOR VALUE TEACHING`

Your city owns 4 km^2 of abandoned land at the edge of town. In which order would you place the following land uses:

a) sell the land to a developer to build a subdivision;
b) lease the land for grazing of livestock;
c) plant trees and grass on the land for future use as a recreation area;
d) lease the land to a strip-mining company so that the city will share in the profits and reclaim the property when the mining operation is complete.

Explain your reasons for ranking these land uses as you did.

CLUES TO QUESTIONS

A controlled experiment is one in which only one variable is changed at a time while all other variables are kept constant. In this activity the only difference should be the soil cover; one box has bare soil while the other box is covered with sod. Other variables such as amount of water poured, rate of pouring, slope of box, construction of box, size of collecting bottle, procedure for filtering water, type of soil, and so on, should remain the same. Some variables such as the amount of moisture already in the soils are difficult to control and should be acknowledged when interpreting results.

TROUBLE SHOOTING

- The two soil samples should, as far as possible, contain the same amount of moisture. The soil should not be too wet.
- The water should be poured in the same way, as far as this is possible.
- Be sure that permission has been obtained to cut pieces of sod for this experiment.

VOCABULARY

inconspicuous
controlled experiment
variable
cover crop
filter
clarity
moisture

CROSS REFERENCES

The Dandelion, pages 39 to 40.

Activity 4(b):
How does mulching affect erosion?

Refer to 4(a) since this activity is very similar.

TIME

same as *Activity 4(a)*

SEASON

same as *Activity 4(a)*

CLASS ORGANIZATION

same as *Activity 4(a)*

EQUIPMENT AND MATERIALS

For each group:
2 wooden boxes 50 cm x 25 cm x 10 cm
watering can
water
2 large-mouthed bottles at least 1 litre in size
soil
leaves, wood shavings, sawdust, straw or grass
2 pieces of wood 2.5 cm thick
writing materials
filter paper

SKILLS AND TECHNIQUES

- same as *Activity 4(a)*

CONCEPTS

Mulching aids greatly in reducing soil erosion.

SUGGESTIONS FOR VALUE TEACHING

Much of the earth is covered with soil of one type or another. Why should we be so concerned about the loss of som of it through erosion?

CLUES TO QUESTIONS

Same as *Activity 4(a)* except that the variable this time is that one box has bare soil and the other has the soil covered with a mulch.

TROUBLE SHOOTING

- Same as *Activity 4(a)* except that mulch, not sod, should be available.

VOCABULARY

mulching

RESOURCES

Discussion with a horticulturalist might help pupils to understand how mulching is used to prevent erosion.

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